Chapter Forty-eight

URBAN HIGHWAYS AND STREETS
(New Construction/Reconstruction)

BUREAU OF DESIGN AND ENVIRONMENT MANUAL

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(New Construction/Reconstruction

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Chapter 48 provides guidance in the design of urban highways and streets. Information that is also applicable to these facilities is included in the following chapters:

- Chapter 14 discusses intersection design studies.
- Chapters 31, 32, 33, 34, and 39 provide guidance on the geometric design elements that are also applicable to these facilities.
- Chapter 36 provides information on the design of intersections, including left- and right-turn lanes, channelization, and intersection sight distances.
- Chapter 38 provides guidelines on roadside safety issues.
- Chapter 58 provides guidelines for off-street parking facilities.

48-1 GENERAL

48-1.01 Functional Classification

Urban highways and streets can be functionally classified as arterials, collectors, and local streets. Most of the State's urban facilities are arterials; however, there are some urban collectors on the State System. Practical improvements to urban collectors usually are more consistent with objectives pursued under the 3R program, which are presented in Chapter 49. For urban collector streets, planning and programming goals only occasionally include new construction and reconstruction of these highways for significant lengths such as between urban destinations. For criteria on new construction and reconstruction of urban collectors and local streets, the designer is referred to the *Bureau of Local Roads and Streets Manual* and AASHTO *A Policy on Geometric Design of Highways and Streets* for guidance.

Chapter 48 presents new construction and reconstruction criteria for urban and suburban arterials.

48-1.02 Closed and Open Suburban Designations

To better designate appropriate design criteria, the Department has divided its functional classifications into rural, suburban, and urban. Chapter 43 discusses the distinction among these area types. The suburban classification has been further subdivided as open or closed. These are defined in Chapter 43.

48-2 GENERAL DESIGN ELEMENTS

48-2.01 Design Speed

The most common design speed for urban streets is 30 mph (50 km/h). In relatively undeveloped locations in urban or closed suburban areas and where economics, environmental conditions, and signal spacing permits, consider using a minimum design speed of 40 mph (60 km/h). Design speeds of 45 mph to 50 mph (70 km/h to 80 km/h) are common in open suburban areas.

48-2.02 Median Types

Section 34-3 discusses the various medians that are used in urban and suburban areas and guidelines for selecting medians and widths. In addition, for medians in suburban and urban arterials, the designer should consider the following:

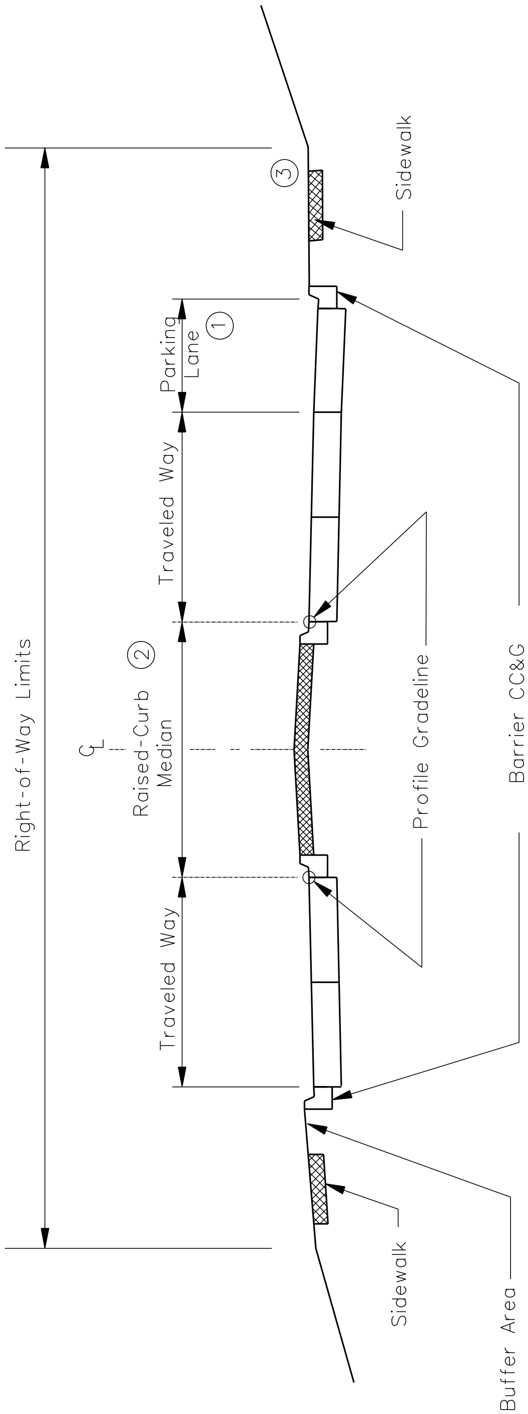
1. Flush/Traversable Medians. These median types may be used in both the urban and suburban areas in conjunction with curb and gutter along the outside edges of the traveled way. For most applications, the flush TWLTL should be used. However, in larger metropolitan areas, a traversable TWLTL may be used. Section 48-4 further discusses the use of both types of TWLTL.

2. Depressed Medians. In open suburban areas, a depressed median may be used. This design is typically used with left shoulders and where the design speed is 50 mph (80 km/h). Section 34-3.03 and Chapter 47 provide further guidance on depressed medians.

3. Raised-Curb Medians. Usually, a raised-curb median is proposed in suburban and urban areas where managed access to the street and control of left-turn movements are desired. Section 34-3.03 provides guidance on the selection and design of raised-curb medians. Figure 48-3.A discusses the advantages and disadvantages of raised-curb medians as compared to TWLTL medians. Chapter 36 illustrates typical treatments for left-turn lanes within raised-curb medians.

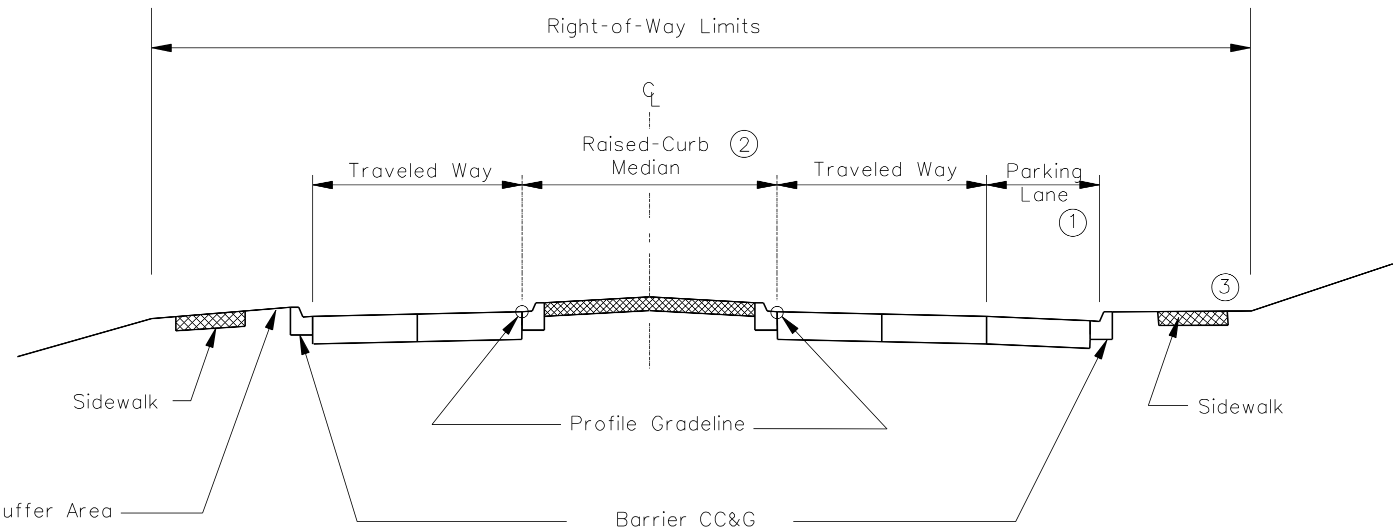
48-2.03 Typical Sections

Figures 48-2.A through 48-2.H present the typical cross sections for the various urban facilities. For a typical six-lane urban arterial with a raised-curb median, see Figure 34-3.B. Give consideration to safe accommodation of pedestrians and bicyclists during the development of the project. Chapter 17 provides detailed guidelines for these issues.



TYPICAL TANGENT SECTION FOR URBAN ARTERIALS
(Raised-Curb Median)

Figure 48-2.A

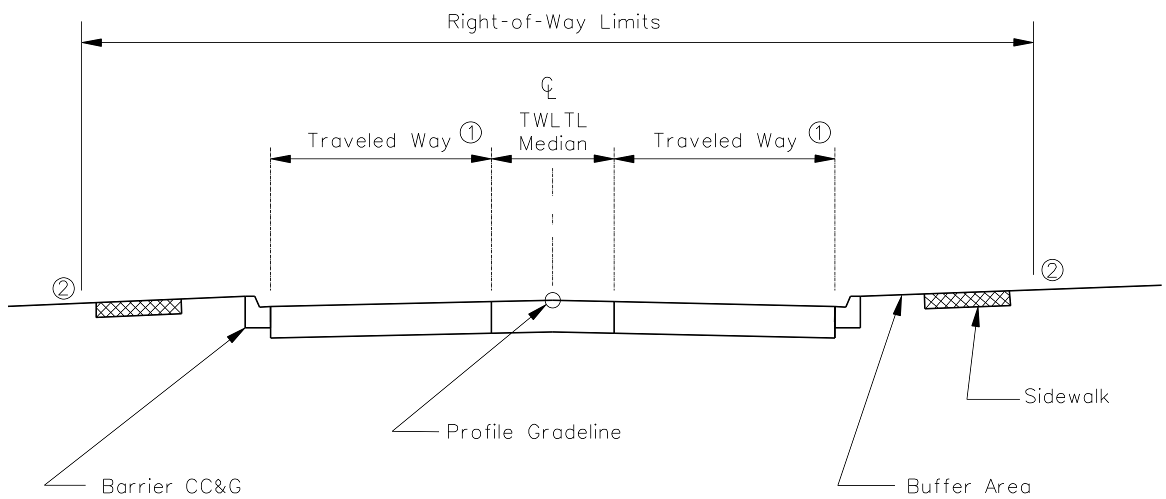


Notes:

1. *Consider off-street parking.*
2. *See Figure 34-3.B for slope of gutters along the median.*
3. *See Section 34-4 for alternative slope designs behind the sidewalk.*

TYPICAL TANGENT SECTION FOR URBAN ARTERIALS
(Raised-Curb Median)

Figure 48-2.B

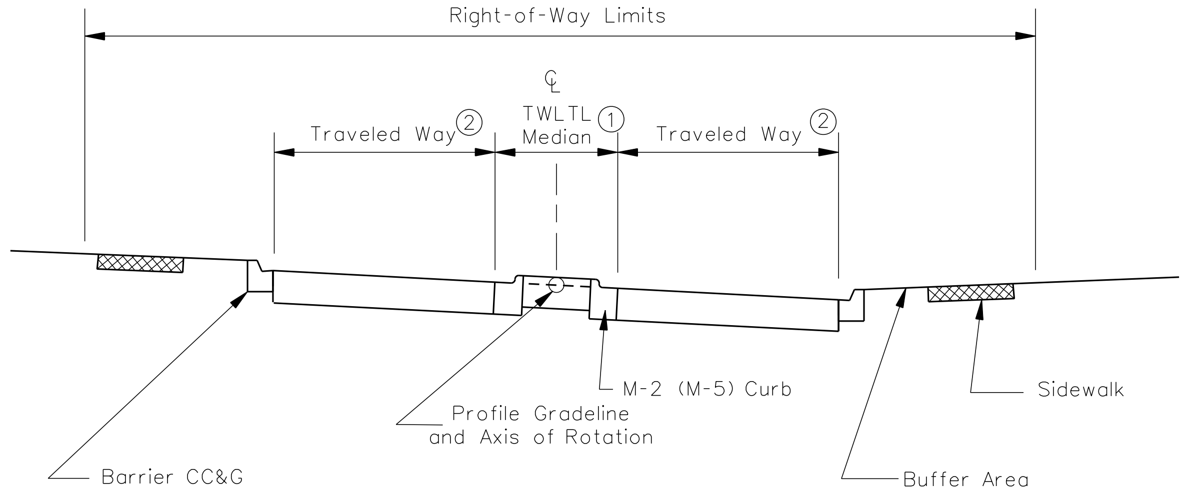


Notes:

1. *Traveled ways may be either one or two lanes.*
2. *See Section 34-4 for alternative slope designs behind the sidewalk.*

TYPICAL TANGENT SECTION FOR URBAN ARTERIALS (TWLTL)

Figure 48-2.C

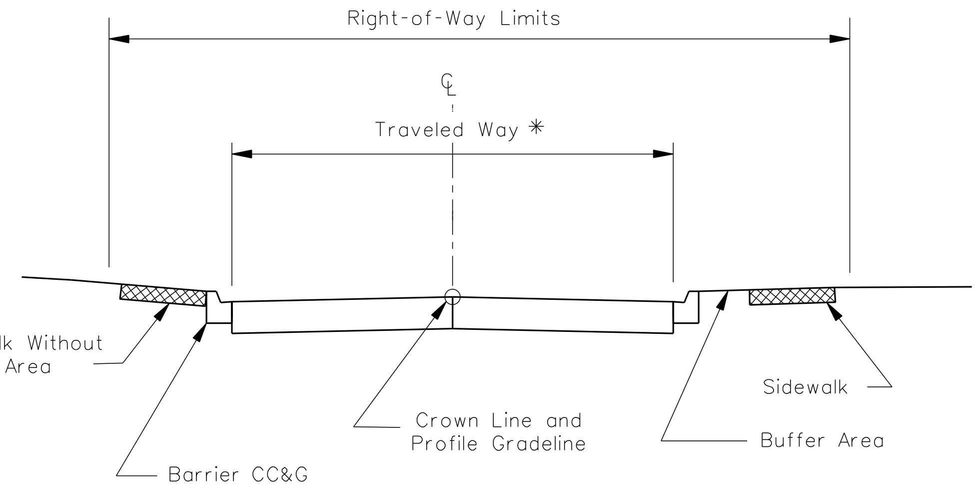


Notes:

1. *Within the limits of the horizontal curve, use M-2.12 (M-5.30) CC&G along the median edges to control drainage.*
2. *Traveled ways may be either one or two lanes.*

TYPICAL SUPERELEVATED SECTION FOR URBAN ARTERIALS (TWLTL)

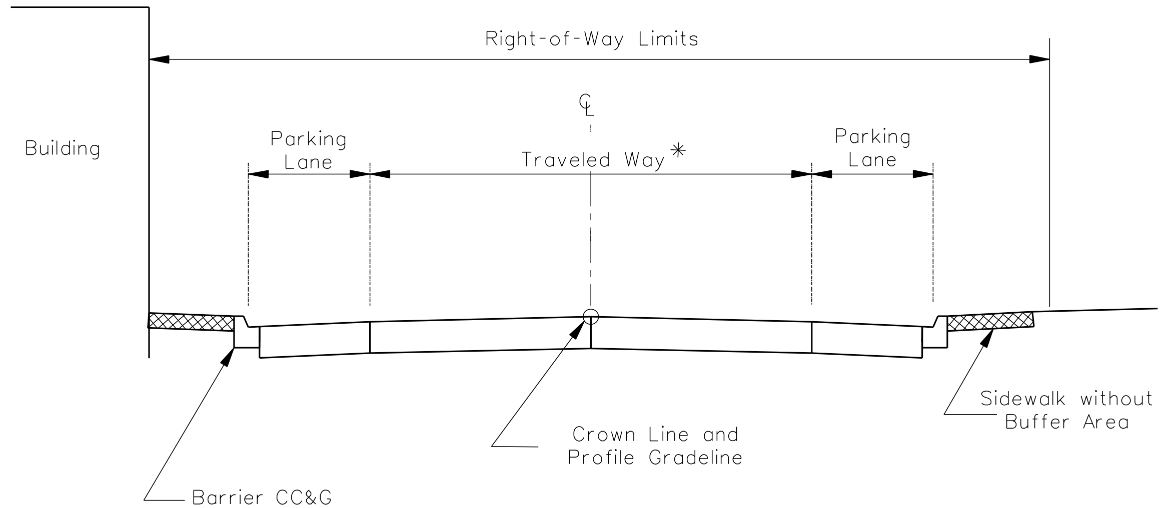
Figure 48-2.D



** The traveled way may have two-way or one-way traffic.*

TYPICAL TANGENT SECTION FOR URBAN ARTERIALS
(Two-Lanes Without Parking)

Figure 48-2.E

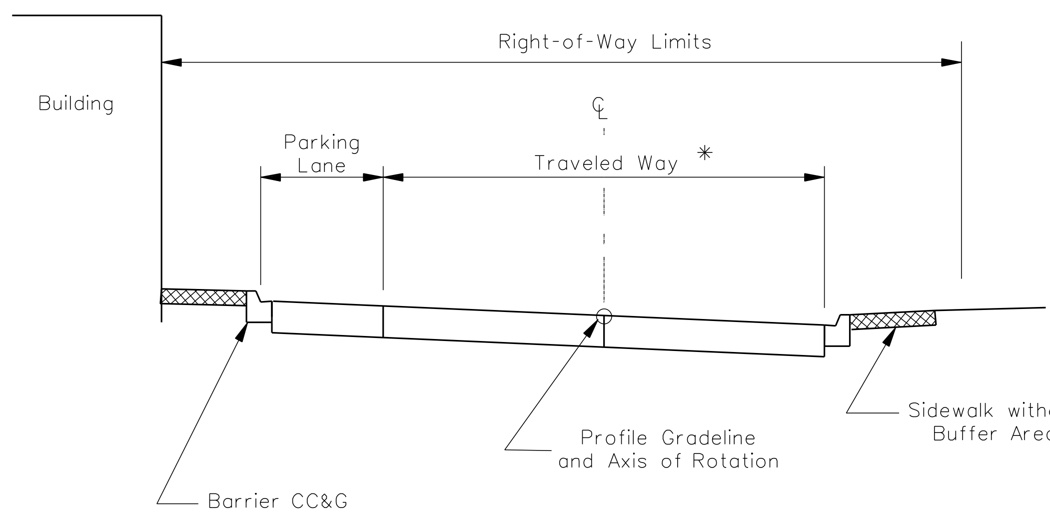


**The traveled way may have two-way or one-way traffic.*

Note: For consistency, see Figures 48-2.E, 48-2.G, and 48-2.H.

TYPICAL TANGENT SECTION FOR URBAN ARTERIALS
(Two-Lanes With Parking Both Sides)

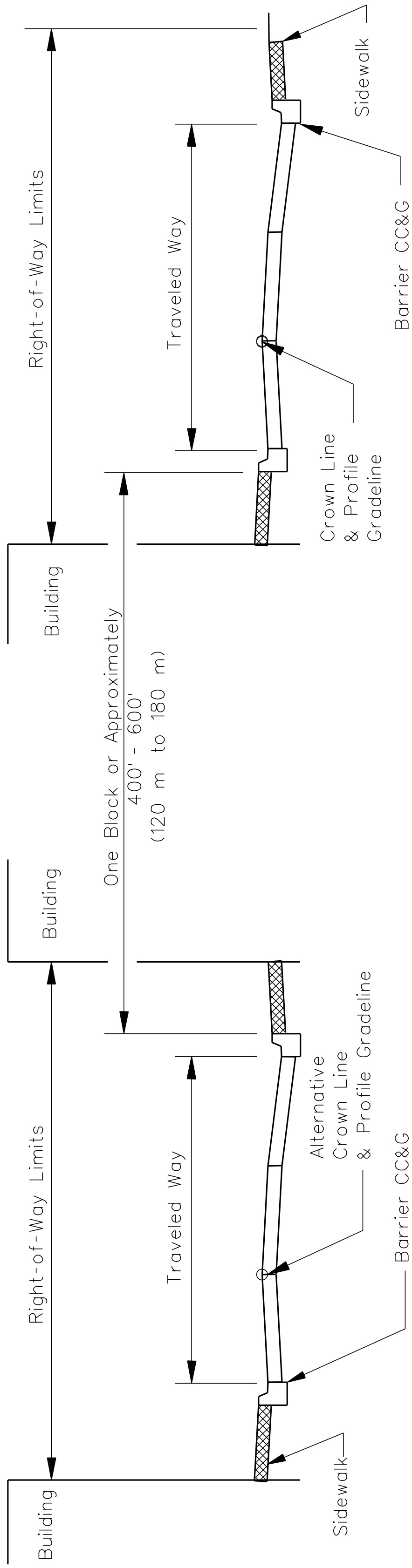
Figure 48-2.F



** The traveled way may have two-way or one-way traffic.*

TYPICAL TANGENT SECTION FOR URBAN ARTERIALS
(Two-Lanes With Parking on One Side)

Figure 48-2.G



TYPICAL TANGENT SECTION FOR ONE-WAY COUPLE ON URBAN ARTERIALS
(Three-Lanes in Each Direction)

Figure 48-2.H

48-2.04 Sidewalks

Sidewalks are considered integral parts of the urban environment. In these areas, travelers frequently choose to make their trip on foot, and pedestrians desire to use a paved surface for the trip. When constructing sidewalks, the designer should consider the following:

1. Warrants. In general, if pedestrian activity is anticipated, provide sidewalks along all curbed suburban and urban facilities. Extend all sidewalks to logical termini. If sidewalks are not provided in the initial design, grading should be completed so that sidewalks can be added in the future. If sidewalks will not be installed, the designer should confer with local officials to ensure that sidewalks are not required or desired.

   New sidewalks or sidewalks replaced because of deterioration that meet these warrants, will only be constructed if the local agency is willing to participate financially and assume the maintenance responsibility for the sidewalk in accordance with the criteria in Chapter 5.

2. Widths. A typical sidewalk is 5 ft (1.5 m) wide. If no buffer area is provided, the sidewalk should be 7 ft (2.0 m) wide to accommodate any appurtenances that may be included in the sidewalk; see Item #4 below. High pedestrian volumes may warrant greater widths in business areas and school zones. In these cases, a detailed capacity analysis may be required to determine the sidewalk width. Use the *Highway Capacity Manual* for this analysis.

3. Buffer Areas. If the available right-of-way is sufficient, provide a buffer area between the back of curb and sidewalk. These areas provide space for snow storage, utilities, and allow a greater separation between vehicles and pedestrians. The buffer area should be 2 ft to 3 ft (600 mm to 900 mm) wide to be effective and wider if practical. Buffer areas may also be used for the placement of roadside appurtenances.

4. Appurtenances. Where a buffer area cannot be provided, the designer must consider the impact of roadside appurtenances within the sidewalk (e.g., mailboxes, fire hydrants, parking meters, utility poles) as these elements typically reduce the usable width of the sidewalk and interfere with pedestrians activity. Typically, a 1 ft (300 mm) minimum width is provided between the sidewalk and right-of-way line. Utility poles usually can be located behind the sidewalk in this area providing a clear sidewalk width.

5. CBD Areas. In central business districts, the entire area between the back of curb and the front of buildings is fully paved as a sidewalk.

6. Disabled Accessibility. The design of the sidewalk (e.g., sidewalk width, cross slope, longitudinal grade, curb ramps) along public rights-of-way must meet the ADA criteria presented in Chapter 58.

7. Bridges. In general, if there is or expected to be pedestrian activity across a bridge, include sidewalks on both sides of the bridge. On long bridges, it may be more cost effective to provide a single sidewalk on one side. However, a safe crossing must be

provided in advance of the bridge if there is evidence of pedestrian activity on both sides of the roadway. See Chapter 39 for typical sections.

48-2.05 Parking

For most urban projects, the designer must evaluate the demand for parking. Desirably, these parking needs will be accommodated by providing off-street parking facilities. Chapter 58 provides information on the design and layout of off-street parking facilities. When providing on-street parking along urban streets, the designer should evaluate the following:

1. Warrants. Do not introduce any new parking lanes along State highways. On-street parking reduces capacity, impedes traffic flow, and may produce undesirable traffic operations or may increase the crash potential. On State reconstruction projects, consider removing parking lanes. Removal of existing or revising existing on-street parking configurations will require coordination and concurrence with local officials and adjacent businesses. Chapter 58 discusses the procedures and guidelines for replacing on-street parking with off-street parking.

2. Local Agreements. Prior to implementation of parking on a project, the State will enter into a joint agreement with the municipality; see Chapter 5. The municipality will be required to maintain the parking lane and adopt and enforce an appropriate parking ordinance or provide copies of an existing ordinance in effect. Attach the ordinance to the joint improvement agreement as an exhibit and make a part thereof prior to execution of the agreement on behalf of the State. Enforcement of the ordinance is understood to include erection and maintenance of any necessary NO PARKING or PARALLEL PARKING ONLY signs.

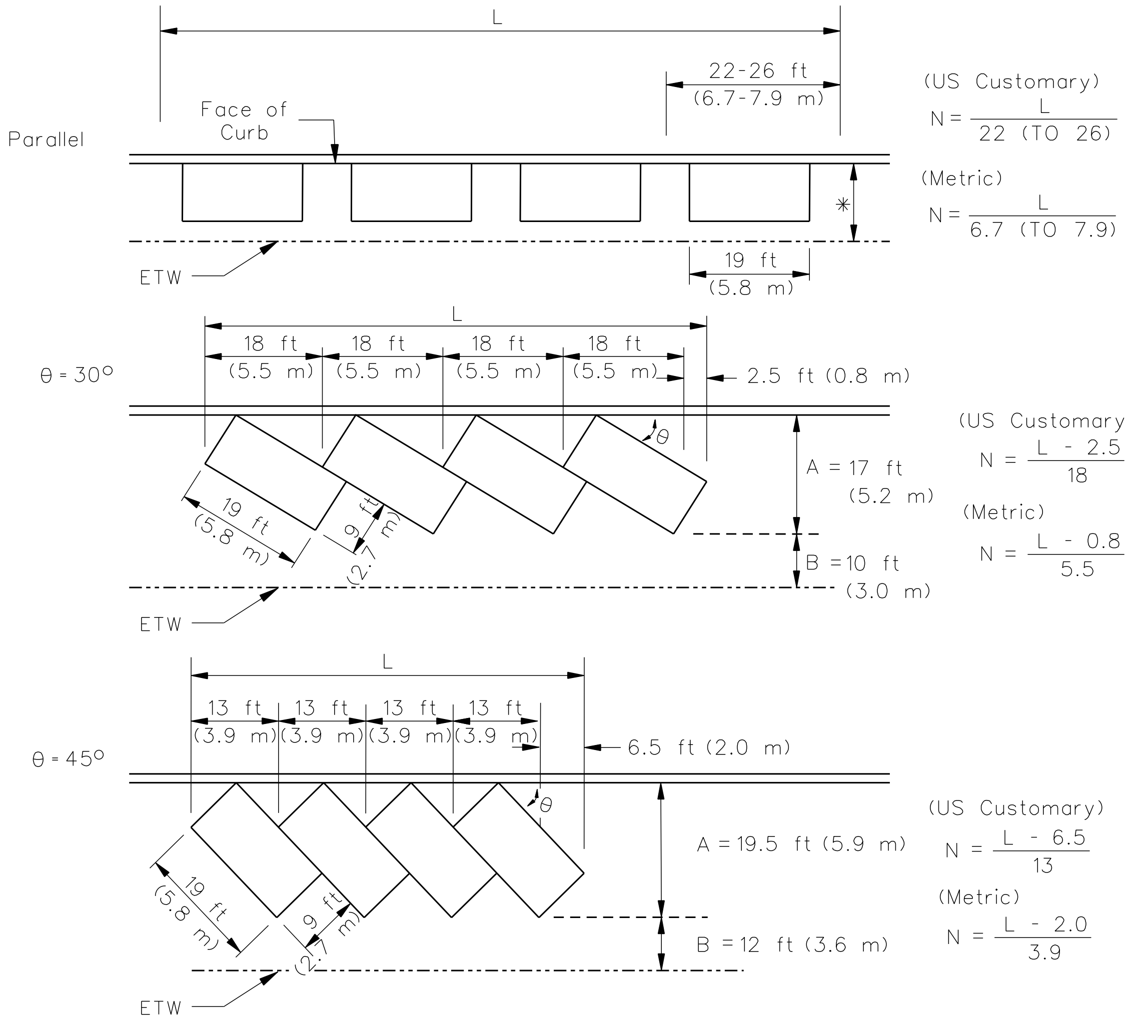
3. Configurations. There are two basic types of on-street parking — parallel and angle parking. These are illustrated in Figure 48-2.I.

4. Design Considerations.

    a. Department Authority. The *Illinois Vehicle Code* authorizes the Department to determine the propriety of diagonal parking upon routes under its jurisdiction. Section 11-1304(c) of the *Code* states:

        > *Local authorities may permit angle parking on any roadway, except that angle parking shall not be permitted on any federal-aid or state highway unless the Department has determined the roadway is of sufficient width to permit angle parking without interfering with the free movement of traffic.*

    b. Capacity. Parallel parking is the preferred arrangement where street space is limited and traffic capacity is a major factor. Where angle parking is provided, the overall level of service for the facility preferably should be not less than C.



** See Figures 48-6.A and 48-6.B for parallel parking lane widths.*
See Chapter 49 for 3R widths.

A + B = Parking Width for Angle Parking.

Key:

L = given curb length with parking spaces

N = number of parking spaces over distance L

A = required distance between face of curb and back of stall, assuming that bumper of parked car does not extend beyond curb face.

B = clear distance needed for a parked vehicle to back out of stall while just clearing adjacent parked vehicles.

ETW = Edge of Traveled Way

CURB PARKING CONFIGURATIONS

Figure 48-2.I

c. Number of Spaces. Angle parking provides more spaces per linear foot (meter) than parallel parking, but requires a greater cross street width.

d. Angle. Angle parking should be 45° or less.

e. Backing Maneuver. Angle parking requires the driver to back into the traveled way when sight distance may be restricted by adjacent parked vehicles. This maneuver may surprise an approaching motorist. As indicated in Figure 48-2.I, the parked car will require a certain distance "B" to back out of its stall. Whether or not this is a reasonably safe maneuver will depend upon the number of lanes in each direction, lane widths, operating speeds, traffic volumes during peak hours, parking demand, and turnover rate of parked vehicles.

f. Crashes. After analyzing backing maneuver space, angle parking may be considered to remain if there is no history of crashes relating to the existing angle parking.

g. Trucks. If the truck traffic on the facility is 10% or more of the ADT, angle parking should be removed.

h. Agreement. The agreement with local officials must include provisions for monitoring and maintaining the angle parking after the project is completed to determine if safety or capacity problems develop as traffic volumes increase.

5. Stall Dimensions. Figure 48-2.I provides the width and length criteria for parking stalls of various configurations. The figure also indicates the number of stalls that can be provided for each parking configuration for a given curb length. The surface widths in Figures 48-6.A and 48-6.B assume parallel parking on one or both sides of the street.

6. ADA Requirements. Chapter 58 presents the accessibility requirements for on-street parking for disabled persons.

7. Location. When locating parking spaces, the designer should consider the following:

- Parking is prohibited within 20 ft (6.1 m) of any crosswalk.

- Prohibit parking within 10 ft to 16 ft (3 m to 5 m) of the beginning of the curb radius at mid-block driveway entrances.

- Parking is prohibited within 50 ft (15.2 m) of the nearest rail of a highway/railroad crossing.

- Parking is prohibited within 15 ft (4.6 m) of a fire hydrant.

- Parking is prohibited within 30 ft (9.1 m) on the approach leg to any intersection with a flashing beacon, stop sign, or traffic control signal.

- Parking is prohibited on bridges or within a highway tunnel.

- Prohibit parking from areas designated by local traffic and enforcement regulations (e.g., near school zones, loading zones, bus stops). See local ordinances for additional information on parking restrictions.

- Check intersection sight distance to side roads.

- Eliminate parking across from a T intersection.

48-3 RAISED-CURB MEDIANS

48-3.01 General

Figure 48-3.A presents advantages and disadvantages of raised-curb medians as compared to TWLTL medians. Section 34-3.03 provides guidance on the selection and design of raised-curb medians.

48-3.02 Four Lanes with Median

The most common typical section with raised-curb medians is two lanes in each direction separated by the curbed median; see Figures 48-2.A and 48-2.B.

48-3.03 Six Lanes with Median

Where traffic volumes indicate a need for three lanes in each direction, the recommended median design is a raised-curb. See Figure 34-3.B for a typical cross section design. Where there is a need for dual left turns, the minimum width of the median is 30 ft (9.5 m). Where major intersections are closely spaced and there is a need for dual lefts at most intersections, provide the 30 ft (9.5 m) median width along the entire street.

Where a five-lane facility exists and traffic volumes (ADT > 40,000) and/or capacity analysis warrants a six-lane design, consider providing a traversable type median with M-2 (M-5) curb. Prior to incorporating the M-2 (M-5) curb median into the design, evaluate the following:

1. Concentrated Left-Turn Movements. With raised-curb medians, left-turn movements are concentrated at the intersections, thereby reducing the overall conflict areas of the facility. However, drivers are forced to make all left turns at the intersections, which may overload the capacity of the intersections, increase driver travel time, and may create the need for U-turns at intersections.

2. Businesses. Business owners may perceive an adverse effect when a raised-curb median is proposed. See NCHRP 395 *Capacity and Operations Effects of Midblock Left-Turn Lanes* for guidance on the effects of curbed medians.

3. Opposing Gaps. Six-lane facilities contain high-traffic volumes that limit opportunities for left-turns across the opposing traffic. NCHRP 395 discusses the consequences of these movements on the facility.

4. Merging Gaps. Entering a six-lane facility with a M-2 (M-5) curbed median from a non-signalized side access point provides a considerable challenge for the driver. Upwards of nine different movements may need to be observed by the driver at any given time. Where M-2 (M-5) curbed facilities are justified, the TWLTL can be used as a waiting area before a gap occurs and a merge can take place. For additional concerns, see NCHRP 330 *Effective Utilization of Street Width on Urban Arterials*.

Advantages	Disadvantages
1. Provides an area for left-turn maneuvers.	1. Increases travel time and delay for many left-turning vehicles.
2. Discourages arbitrary crossings of the median.	2. Restricts direct access to adjoining properties.
3. Reduces the number of vehicular conflict points.	3. Installation and maintenance costs are higher.
4. Allows for better access management along the street increasing safety performance.	4. Can create an over concentration of turns at median openings.
5. Provides a positive and safer separation between opposing traffic flows.	5. Indirect routing may be required.
6. Provides a median refuge area for pedestrians.	6. May restrict access for emergency vehicles (e.g., fire, police, ambulance).
7. Provides a location for traffic control devices (e.g., signs, signals, lighting).	7. Lack of operational flexibility.
8. Provides an open space for aesthetic considerations and stormwater management.	8. When accidentally struck, curb may cause a driver to lose control of the vehicle.
9. Provides for enhanced traffic flow and reduces conflicts.	9. A minimum median width of 22 ft (7 m) is needed to accommodate U-turns or to shadow stopped passenger cars in the median when turning left or crossing through a median opening from a side street.

ADVANTAGES AND DISADVANTAGES OF RAISED-CURB MEDIANS

Figure 48-3.A

48-4 FLUSH OR TRAVERSABLE TYPE MEDIANS

48-4.01 TWLTL Guidelines

The applicability of a TWLTL is a function of the traffic conditions that result from the adjacent land use. Evaluate the area to determine the relative attractiveness of a flush median as compared to a raised-curb median. For example, a TWLTL may perpetuate more strip development. When this is not desirable, use a raised-curb median. For additional information on the use of a TWLTL design or flush alternating left-turn lanes along a street, see NCHRP 395 *Capacity and Operational Effects of Midblock Left-Turn Lanes* and Figures 34-3.C and 34-3.D. Also consider the following guidelines:

1. General. Only provide TWLTL in:
   - areas with a high number of existing driveways per mile (km) (e.g., 10-35 driveways total per mile (20-55 driveways total per km) on both sides of street);
   - areas of existing high-density commercial development;
   - areas with substantial mid-block left turns; and/or
   - areas where space is not available for raised-curb median widths and a need for left-turn lanes exists.
2. Highway Type. Two-lane and four-lane undivided urban or suburban arterials are the most common candidates for the implementation of a TWLTL design. Once these streets are reconstructed, they are commonly referred to as three-lane and five-lane facilities, respectively.
3. Traffic Volumes. Traffic volumes and the percent of left turns in each direction are a significant factor in the consideration of a TWLTL. Use a 20-year design for traffic volumes. As general guidance, consider the following:
   a. Two-Lane Facilities. On existing two-lane roadways, a TWLTL design will often be advantageous for traffic volumes between 5,000 and 14,000 ADT.
   b. Four-Lane Facilities. On existing four-lane undivided highways, a TWLTL will often be advantageous for traffic volumes between 10,000 and 40,000 ADT. The 40,000 ADT value assumes left-turn percentages less than or equal to 30%.
   c. Six-Lane Facilities. The decision on whether to provide a TWLTL or a raised-curb median will be determined on a case-by-case basis. See Section 48-3.03 for guidance.
   d. Pedestrians. Pedestrian crossing volumes are also a consideration because of the large paved area that must be traversed when a TWLTL is present (i.e., no pedestrian refuge exists). There may be significant delays for vehicles at signalized intersections to accommodate pedestrians having to cross the

highway in one movement. A raised-curb median may provide a refuge area for pedestrians to cross the highway in two movements.

4. Speed. The design speed of an urban street is a major factor in TWLTL applications. Experience indicates that design speeds from 25 mph to 45 mph (40 km/h to 70 km/h) will properly accommodate TWLTL operations. For design speeds higher than 45 mph (70 km/h), the use of TWLTL is not recommended.

5. Crash History. On urban or suburban arterials without medians, traffic conflicts often result because of a significant number of mid-block left turns combined with significant opposing traffic volumes. This may lead to a disproportionate number of mid-block, rear-end, and/or sideswipe crashes. The inclusion of a median for left turns is likely to reduce these types of crashes. Review and evaluate the available crash data to determine if disproportionately high numbers of these crashes are occurring.

6. Advantages and Disadvantages. Figure 48-4.A summarizes some of the advantages and disadvantages of a TWLTL median design.

48-4.02 Design Criteria

48-4.02(a) Median Width

Existing highways that warrant the installation of a TWLTL are often located in areas of restricted right-of-way, and conversion of the existing cross section may be difficult. To obtain the TWLTL width, the designer may have to consider the following:

- reducing the width of existing through lanes and analyzing side road radius returns,
- eliminating existing parking lanes and reconstructing curb and gutter and sidewalks,
- eliminating existing shoulders and ditches,
- eliminating existing buffer areas behind curbs and reconstructing curb and gutter and existing sidewalks,
- acquiring additional right-of-way to expand the pavement width by the amount needed for the TWLTL and sidewalks, and/or
- removing an existing raised-curb median.

See Sections 34-3.03 and 34-3.04 for further guidance on medians.

Advantages	Disadvantages
1. Provides an area for left-turn maneuvers. 2. Reduces circuitous travel distance and delay for left-turn vehicles. 3. Permits direct access to adjoining properties. 4. Provides separation between opposing traffic flows. 5. Eliminates the median island fixed object. 6. Provides temporary refuge for disabled vehicles. 7. Serves as temporary lane for emergency, maintenance, and construction activities. 8. Can be used as a reversible lane during peak hours. 9. Can be used to increase emergency vehicle efficiency. 10. Requires less right-of-way for left turns as compared to raised-curb medians.	1. Does not provide a pedestrian refuge area. 2. Does not guarantee unidirectional use at high-volume intersections unless left-turn bays are outlined with curb and gutter. 3. Allows numerous traffic conflict points to remain with no restrictions. 4. Allows for unrestricted development and turning movements along a street. 5. Cannot be used in areas where sight distance is restricted along the street. 6. Adds to drainage problems on the low side of superelevated horizontal curves. 7. May promote higher running speeds where proposed with paved outside shoulders and ditch sections. 8. May require reconstruction of inter-sections.

ADVANTAGES AND DISADVANTAGES OF FLUSH OR TRAVERSABLE TWLTL MEDIANS

Figure 48-4.A

48-4.02(b) Intersection Treatment

At intersections with public roads, consider the following:

1. Side Streets/Major Entrances. At intersections, convert the TWLTL to an exclusive left-turn lane and omit the pavement markings through the intersection. However, where turning volumes to minor streets are low, it will not be necessary to convert the TWLTL markings to an exclusive left-turn lane.

2. Turning Volumes. The left-turn demand into intersecting side streets is a factor in determining the appropriate length of the left-turn lane. As a general rule in urban areas, the minimum storage length will govern the length of left-turn lanes; see Section 36-3.02.

3. Minimum Length of TWLTL. The TWLTL should have sufficient length to operate properly, and the type of intersection treatments will determine the length of the TWLTL. Typically, the minimum length will be 650 ft to 1000 ft (200 m to 300 m) (one block long). The final decision on the length of the TWLTL will be based on site conditions.

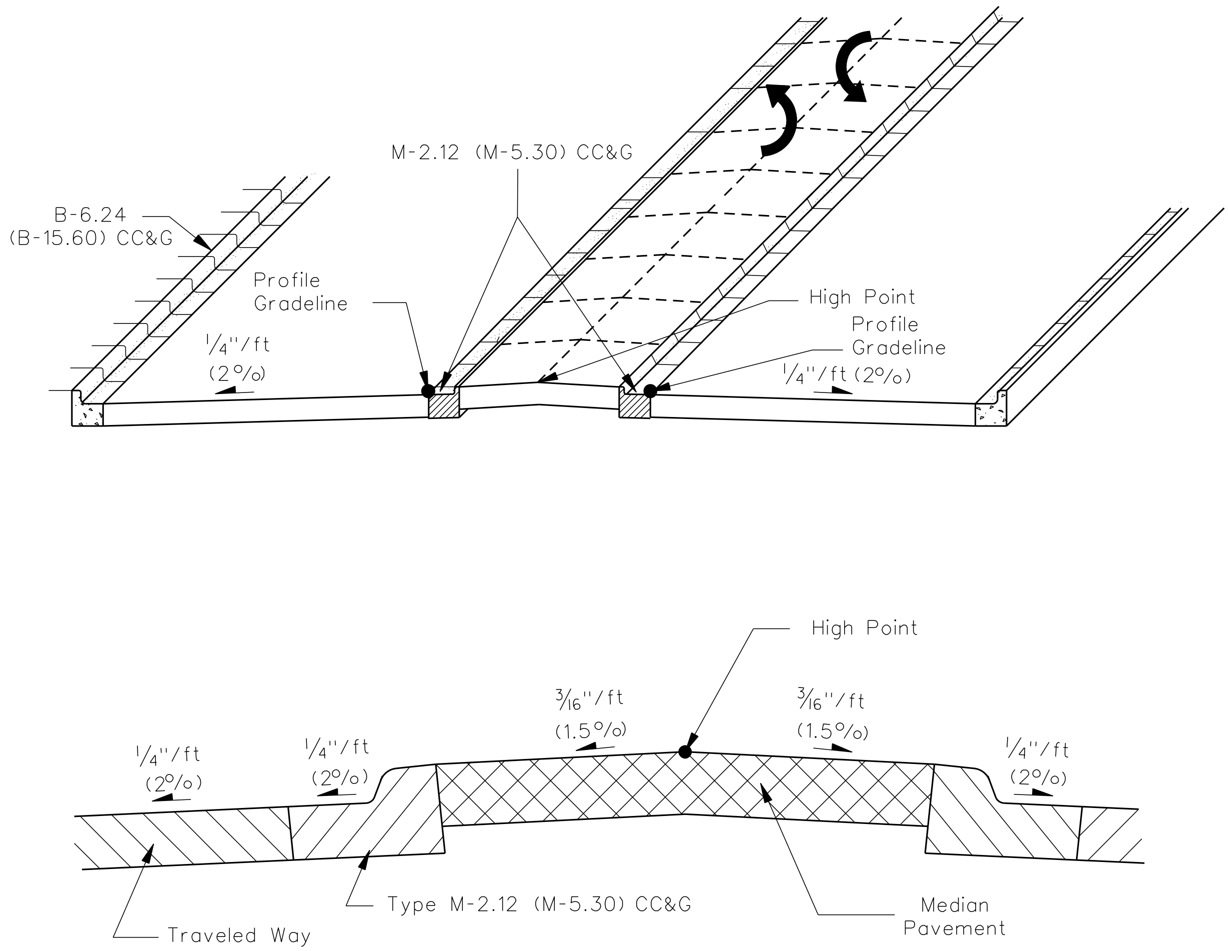
4. Operational/Safety Factors. Provide proper signing and stopping sight distance at the beginning and end of each TWLTL. Where a number of turning movements are expected into and out of entrances located close to a major intersection, it is desirable to design a raised-curb median (M-6 (M-15)) into the segment of the exclusive left-turn lane; see Figure 34-3.D.

48-4.02(c) Curbing

In urban and suburban areas where a TWLTL is used, provide curb and gutter along the outside edges of the traveled way.

48-4.02(d) Traversable TWLTL

On most highways and streets, the TWLTL will be a flush design with the adjacent travel lanes. See Figures 34-3.D and 48-2.C. Where traffic volumes and mid-block left turns are unusually high, a traversable TWLTL median with an M-2.12 (M-5.30) CC&G may be a more appropriate design option. Figure 48-4.B illustrates the typical design for a traversable TWLTL. The M-2 (M-5) curb is used to delineate the edges of the TWLTL and traffic is allowed to turn left across the median. Also, where a horizontal curve with superelevation is proposed along a street with a flush TWLTL, use the M2.12 (M-5.30) CC&G along the median edges of the curve to improve drainage; see Figure 48-2.D.



Note: Drain the median surface away from the high point of the median.

TYPICAL TRAVERSABLE TWLTL CROSS SECTION

Figure 48-4.B

48-4.03 Railroad Crossings

TWLTLs are not extended across a highway/railroad grade crossing. Terminate the TWLTL 150 ft to 200 ft (45 m to 60 m) in advance of the crossing and provide a raised-curb median adjacent to the railroad; see Figure 7-3.E. In addition, the designer should coordinate the design with the Bureau of Operations.

48-5 HORIZONTAL ALIGNMENT

48-5.01 General Application

For urban and suburban streets and highways, the application of horizontal alignment criteria will depend on several factors. Figure 48-5.A summarizes the application of horizontal alignment criteria to urban facilities. The remainder of Section 48-5 specifically discusses the application to low-speed urban streets ($V \leq 45$ mph (70 km/h)).

48-5.02 General Superelevation Considerations

For low-speed urban streets, the operational conditions and physical constraints are significantly different than those on rural highways and high-speed urban highways. The following lists some of the characteristics of low-speed urban streets that often complicate superelevation development:

1. Roadside Development/Intersections/Driveways. Built-up roadside development is common adjacent to low-speed urban streets. Matching superelevated curves with many driveways, intersections, sidewalks, etc., creates considerable complications. For example, this may require reconstructing the profile on side streets, and re-grading parking lots, lawns, etc., to compensate for the higher elevation on the high side of the superelevated curve.

2. Non-Uniform Travel Speeds. On low-speed urban streets, travel speeds are often non-uniform because of frequent signalization, stop signs, vehicular conflicts, etc. It is undesirable for traffic to stop on a superelevated curve, especially when snow or ice is present.

3. Limited Right-of-Way. Superelevated curves often result in more right-of-way impacts than would otherwise be necessary. Right-of-way is often restricted along low-speed urban streets.

4. Wide Pavement Areas. Many low-speed urban streets have wide pavement areas because of the number of traffic lanes, the use of a flush-type median, or the presence of parking lanes. In general, the wider the pavement area, the more complicated is the development of superelevation.

5. Surface Drainage. Proper cross slope drainage on low-speed urban streets can be difficult even on sections with a normal crown. The minimum longitudinal gradient on a street with curb and gutter is 0.30%. A curve with superelevation (or remove crown) and/or where a flush-type median is proposed introduces another complicating factor unless special features are designed into the median. See Figure 48-2.D, which illustrates the use of M-2.12 (M-5.30) CC&G to control drainage.

Land Use Category*	Design Speed	Design Assumptions	e_{max}	*BDE Manual* References
Urban [1]	V ≤ 45 mph (V ≤ 70 km/h)	Low-Speed Urban Streets	4.0%	Section 48-5
Closed Suburban	V = 40 or 45 mph (V = 60 or 70 km/h)	Low-Speed Urban Streets	4.0%	Section 48-5
Open Suburban Likely to Become Closed Suburban within next 10 years	V = 45 mph (V = 70 km/h)	Low-Speed Urban Streets	4.0%	Section 48-5
	V = 50 mph (V = 80 km/h)	Open Roadway Conditions	4.0%	Chapter 32
Open Suburban Likely to Remain Suburban for next 10-15 yrs	V = 45 mph (V = 70 km/h)	Low-Speed Urban Streets	4.0%	Section 48-5
	V = 50 or 55 mph (V = 80 or 90 km/h)	Open Roadway Conditions	6.0%	Chapter 32
Urban SRA	V = 30 or 40 mph (V = 50 or 60 km/h)	Low-Speed Urban Streets	4.0%	Section 48-5
Suburban SRA	V = 45 mph (V = 70 km/h)	Low-Speed Urban Streets	4.0%	Section 48-5

** See Sections 48-1.02 and 43-2 for definitions.*

Note: [1] If an exit ramp connects to a facility where low-speed urban street conditions apply and if the intersection is stop or signal controlled, than the last horizontal curve on the exit ramp should be designed assuming low-speed urban street conditions.

HORIZONTAL ALIGNMENT APPLICATIONS IN URBAN/SUBURBAN AREAS

Figure 48-5.A

48-5.03 Horizontal Curves

48-5.03(a) Design Procedures

Because of the unique operational conditions for low-speed urban streets, it is appropriate to use a modified theoretical basis for horizontal alignment criteria when compared to open-roadway conditions. Specifically, the use of AASHTO Method 2 to distribute superelevation and side friction. This Method assumes maximum design side friction is used before any superelevation is introduced. The practical benefit is that most horizontal curves can be designed with little or no superelevation on low-speed urban streets when compared to the criteria for open roadway conditions in Chapter 32. See the AASHTO publication *A Policy on Geometric Design of Highways and Streets* for a further discussion on Method 2.

48-5.03(b) Maximum Superelevation Rate

For new construction projects, use e_{max} = 4.0% for low-speed urban streets. For urban reconstruction projects, existing horizontal curves can remain in place with a superelevation rate up to 6%. However, the use of 6% on a low-speed urban street is a Level Two design exception as discussed in Section 31-8. See Section 36-1.05(b) for a discussion on superelevation for intersections on curves.

48-5.03(c) Minimum Radii

Figure 48-5.B presents the minimum radii for various design speeds for low-speed urban streets. These values should only be used where highly restricted right-of-way conditions exist.

48-5.03(d) Minimum Radii with Retain Normal Crown or Superelevate at Normal Crown

In urban areas, restricted right-of-way conditions usually exist. The radii for superelevation rates of -6% to +6% are shown in Figure 48-5.C. The -2% line provides the minimum curve radii for which a normal crown of ¼ in/ft (2%) should be retained. For radii and design speeds between the -2% line and +2% line, provide a superelevation of 2.0%. For radii and design speeds above the +2% line, superelevate at the indicated rate.

US Customary					
V = Design Speed (mph)	**e_{max}**	**f_{max}**	**e_{max} + f_{max}**	**Calculated Radius (R_{min}) (ft)**	**Radii Rounded for Design (ft)**
20	4.0%	0.27	0.31	86.0	90
25	4.0%	0.23	0.27	154.3	155
30	4.0%	0.20	0.24	250.0	250
35	4.0%	0.18	0.22	371.2	375
40	4.0%	0.16	0.20	533.3	535
45	4.0%	0.15	0.19	710.5	710
Metric					
V = Design Speed (km/h)	**e_{max}**	**f_{max}**	**e_{max} + f_{max}**	**Calculated Radius (R_{min}) (m)**	**Radii Rounded for Design (m)**
30	4.0%	0.28	0.32	22.1	25*
40	4.0%	0.23	0.27	46.7	50*
50	4.0%	0.19	0.23	85.6	86
60	4.0%	0.17	0.21	135.0	135
70	4.0%	0.15	0.19	203.1	203

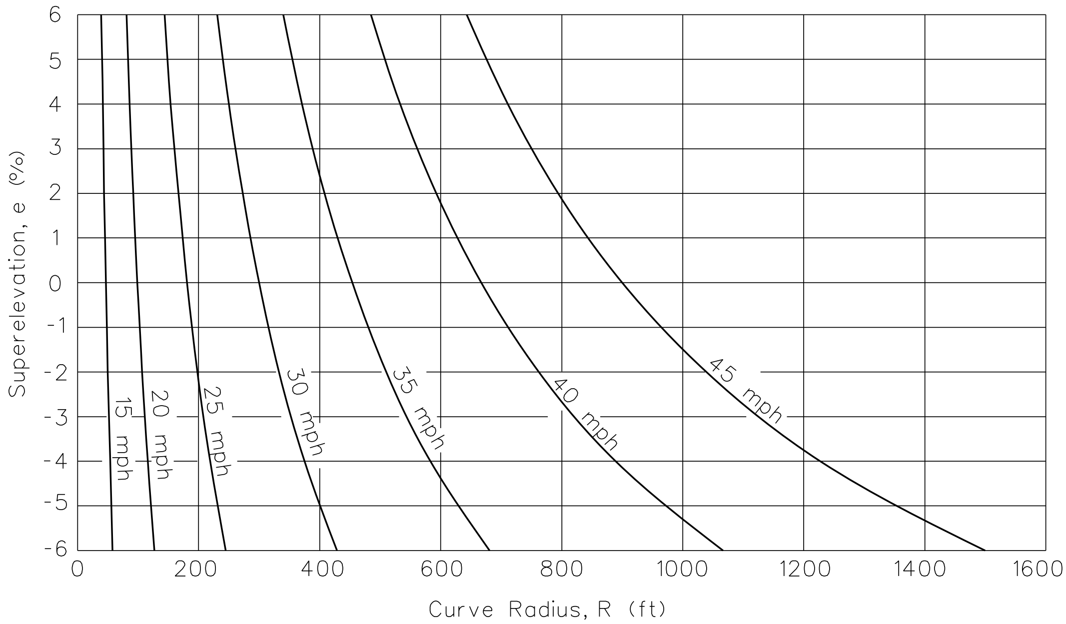
***** *Value rounded up to provide an additional factor of safety for trucks.*

$$R_{min} = \frac{V^2}{15(e_{max} + f_{max})} \quad \text{(US Customary)} \qquad R_{min} = \frac{V^2}{127(e_{max} + f_{max})} \quad \text{(Metric)}$$

MINIMUM RADII ON LOW-SPEED URBAN STREETS

Figure 48-5.B

Also, Figure 48-5.C provides a visual means to select a curve and pavement cross-slope with a higher factor of safety than normally would be used for a certain design speed (i.e., providing a curve and/or superelevation rate with a higher theoretical design speed). This is a useful function provided by the format of the graph for designing horizontal curves at the fringes of urbanized areas. When motorists first enter the edge of an urbanized area, they normally take a few seconds to slow down to the posted urban speed limit, and as a result, it is desirable to provide a higher factor of safety for this speed transition area in conjunction with horizontal curves to the left. With the most common horizontal curve design being one with a normal crown section, the factor of safety can easily be increased by sloping the entire traveled way at the rate of the normal crown slope. Using this design feature thereby minimizes excessive lateral accelerations for inbound motorists.



Notes:

① *The Figure provides a range of design speeds and superelevation rates that apply to a selected curve* radius.

② *AASHTO Method 2 is used to distribute superelevation and side-friction for low-speed urban street conditions. Therefore, the basic point-mass equation applies:*

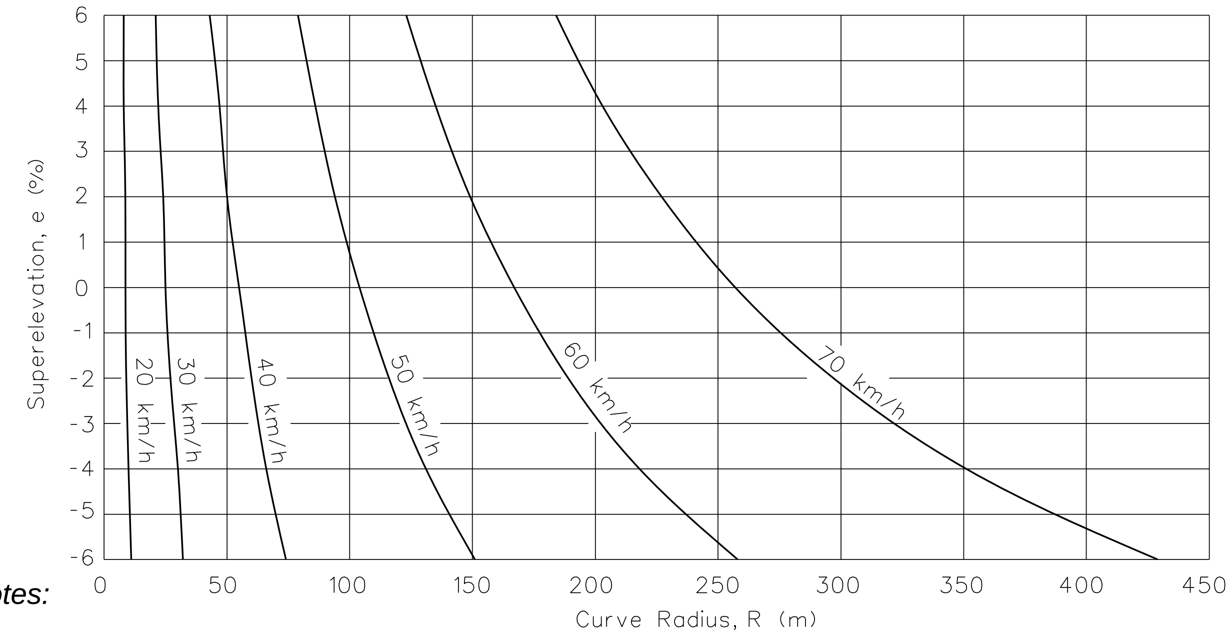
$$R = \frac{V^2}{15(e + f_{max})}$$

Where: *R* = *curve radius, ft*
V = *design speed, mph*
e = *assumed superelevation rate, decimal*
f_{max} = *assumed maximum side-friction factor for selected design speed (see Figure 48-5.B), decimal*

③ *For curves between the -2% and +2% lines, consider removing the crown slope through the curve. This will ensure that maximum comfortable side friction is not exceeded due to a negative slope in one direction of travel. It will also minimize potential rollover of trucks (on dry pavement) with low rollover thresholds and minimize possible skidding of trucks with smooth tires on polished, wet pavement surfaces. On a tangent section, a low-speed urban street normally should be sloped away from the curbed median or centerline of the roadway (5-lane flush) at a minimum cross-slope rate of 1/4″/ft.*

SUPERELEVATION RATES
(Low-Speed Urban Streets)
(US Customary)

Figure 48-5.C



Notes:

① *The Figure provides a range of design speeds and superelevation rates that apply to a selected curve* radius.

② *AASHTO Method 2 is used to distribute superelevation and side-friction for low-speed urban street conditions. Therefore, the basic point-mass equation applies:*

$$R = \frac{V^2}{127\,(e + f_{max})}$$

Where: *R* = *curve radius, m*
V = *design speed, km/h*
e = *assumed superelevation rate, decimal*
f_{max} = *assumed maximum side-friction factor for selected design speed (see Figure 48-5.B), decimal*

③ *For curves between the -2% and +2% lines, consider removing the crown slope through the curve. This will ensure that maximum comfortable side friction is not exceeded due to a negative slope in one direction of travel. It will also minimize potential rollover of trucks (on dry pavement) with low rollover thresholds and minimize possible skidding of trucks with smooth tires on polished, wet pavement surfaces. On a tangent section, a low-speed urban street normally should be sloped away from the curbed median or centerline of the roadway (5-lane flush) at a minimum cross-slope rate of 2%.*

SUPERELEVATION RATES
(Low-Speed Urban Streets)
(Metric)

Figure 48-5.C

48-5.03(e) Superelevated Curves

Figure 48-5.C allows the designer to select a curve with superelevation where a radius to retain normal crown or remove crown slope cannot be achieved.

* * * * * * * *

Example 48-5.02(1)

Given: 22 ft raised-curb median with 24 ft traveled ways in each direction
Design speed = 40 mph
Radius = 800 ft
Cross slope of traveled way = 1/4″/ft (2.0%) in each direction

Problem: Determine if superelevation is needed.

Solution: Figure 48-5.C indicates the assumed design speed can be achieved with an adverse crown slope of up to approximately -2.5%. If the normal crown is maintained throughout the curve, the worst-case superelevation rate in one direction is -2.0%. Therefore, the normal crown can be maintained, and the horizontal curve will provide for the assumed design speed.

Example 48-5.02(2)

Given: Two-lane, two-way street at 30 ft f-f
Design speed = 40 mph
Radius = 650 ft
Cross slope of traveled way = 1/4″/ft (2.0%) in each direction

Problem: Determine if superelevation is needed.

Solution: Figure 48-5.C indicates the assumed design speed can be achieved with a 0% cross slope. The normal crown would provide a rate of -2.0% for the worst-case condition in one direction. The -2.0% will accommodate a vehicular speed of approximately 38 mph. Also the footnote in Figure 48-5.C states that any set of conditions between the -2% and +2% lines should be superelevated at the rate of the normal crown slope. Therefore, the curve should have a superelevation rate of +2.0% across the entire traveled way.

Example 48-5.02(3)

Given: Five-lane section with flush TWLTL
Design speed = 40 mph
Radius = 550 ft (restricted ROW conditions)
Cross slope of traveled way = 1/4″/ft (2.0%)

Problem: Determine if superelevation is needed.

Solution: Figure 48-5.C yields a rate of 4.0%, which is the maximum allowable rate for new construction. Therefore, the entire traveled way should be transitioned and superelevated at this rate. Because this is a five-lane section, use M-2.12 CC&G on both median edges of the horizontal curve for improved drainage.

* * * * * * * *

48-5.03(f) Maximum Deflection Without Curve

It may be appropriate to omit a horizontal curve where very small deflection angles are present. As a guide, the designer may retain deflection angles of about 1° or less on low-speed urban streets. For these angles, the absence of a horizontal curve should not affect aesthetics.

48-5.04 Superelevation Development

48-5.04(a) Transition Length

The superelevation transition length is the distance required to transition the traveled way from a normal crown section to the full design superelevated section. The superelevation transition length is the sum of the tangent runout distance and superelevation runoff length. See Section 32-3. The following applies to low-speed urban streets:

1. Calculation. Section 32-3 presents the methodology for calculating the superelevation runoff and tangent runout for open roadway conditions. This methodology also applies to superelevation transition lengths on low-speed urban streets. Figure 48-5.D presents superelevation runoff lengths (L_1) and tangent runout lengths (TR) for a two-lane urban street, assuming the axis of rotation is about the roadway centerline; i.e., the width of rotation is one travel lane (13 ft (4.0 m)). See Section 32-3 for guidelines on determining modifications to the superelevation transition distance where the width of rotation is more than one travel lane. Include the plot of the pavement edges in the construction plans to ensure a smooth profile design. See Section 63-4.07(b).

2. Portion of Superelevation Runoff Prior to Curve. Typically, 67% of the superelevation runoff length will be placed on tangent and 33% on curve. Exceptions to this practice may be necessary to meet field conditions. Generally, the accepted range is 60%-80% on tangent and 40%-20% on curve.

US Customary								
Design Speed (mph)	Superelevation Transition Lengths							
	e ≤ 2.5%		3.0%		3.5%		4.0%	
	L_1 (ft)	TR (ft)	L_1 (ft)	TR (ft)	L_1 (ft)	TR (ft)	L_1 (ft)	TR (ft)
20	44	35	53	35	62	35	70	35
25	47	37	56	37	65	37	75	37
30	50	40	59	40	69	40	79	40
35	52	42	63	42	73	42	84	42
40	56	45	67	45	78	45	89	45
45	60	48	72	48	84	48	96	48
Metric								
Design Speed (km/h)	Superelevation Transition Lengths							
	e ≤ 2.5%		3.0%		3.5%		4.0%	
	L_1 (m)	TR (m)	L_1 (m)	TR (m)	L_1 (m)	TR (m)	L_1 (m)	TR (m)
30	13	11	16	11	19	11	21	11
40	14	11	17	11	20	11	23	11
50	15	12	18	12	22	12	25	12
60	17	13	20	13	23	13	27	13
70	18	15	22	15	25	15	29	15

SUPERELEVATION TRANSITION LENGTHS FOR TWO-LANE STREETS
(Low-Speed Urban Streets with 13 ft (4.0 m) Lanes)

Figure 48-5.D

48-5.04(b) Axis of Rotation

On low-speed urban streets, the axis of rotation for horizontal curves is as follows:

1. Two-Lane Facilities. The axis of rotation is typically about the centerline of the roadway.

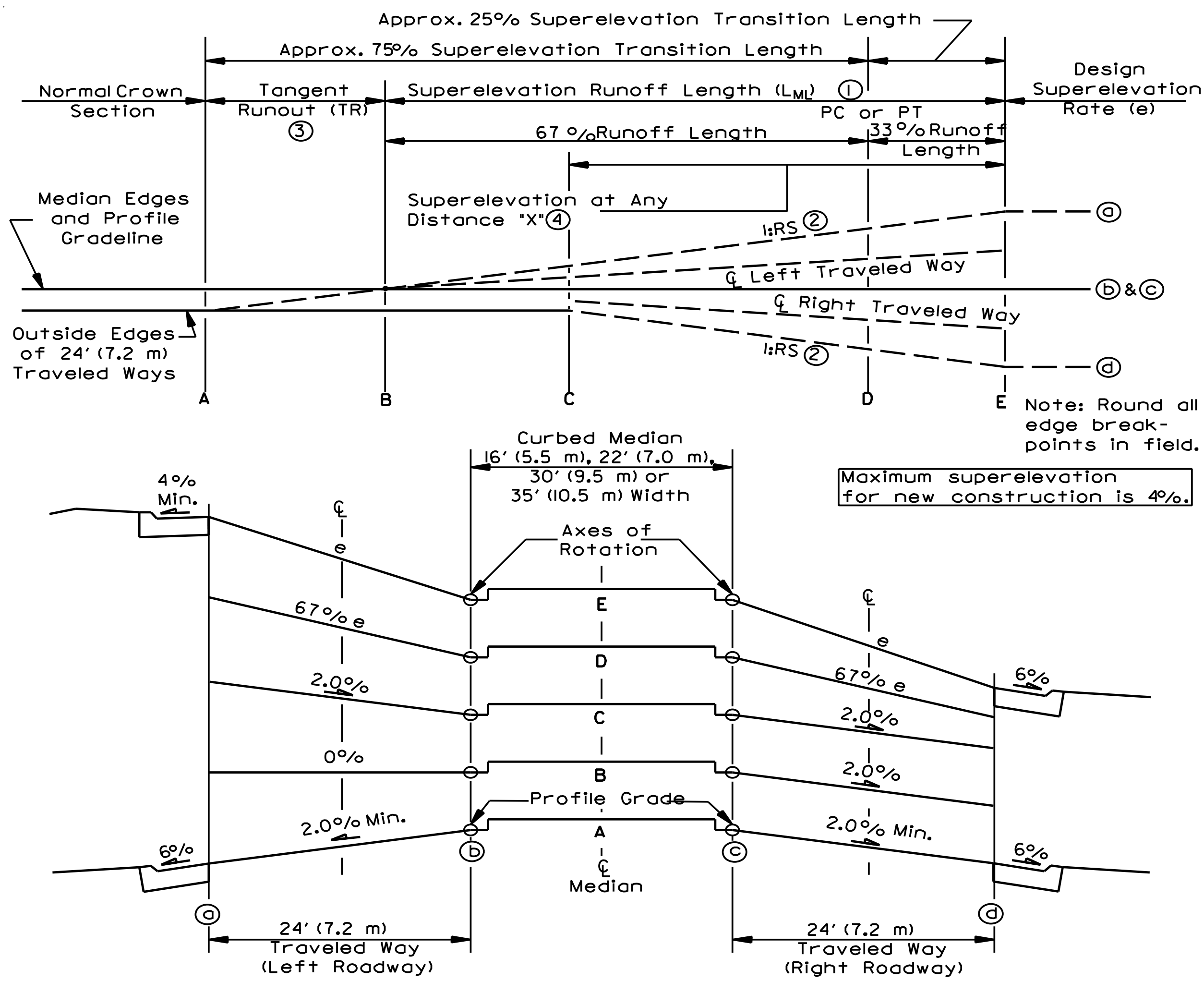
2. Multilane Facilities (Median Width ≤ 16 ft (5.0 m)). The axis of rotation is typically about the centerline of roadway or median.

3. Multilane Facilities (Median Width > 16 ft (5.0 m)). The axis of rotation is typically about the two median edges.

Low-speed urban streets may also present special problems because of the presence of two-way, left-turn lanes; turning lanes at intersections; intersections with major crossroads; drainage; etc. For these reasons, the axis of rotation may be determined on a case-by-case basis.

48-5.05 Typical Designs

See Figures 48-5.E and 48-5.F for typical multilane designs on low-speed urban streets that illustrate the superelevation transitions. See Figure 32-3.J for superelevation transitions on two-lane streets.



① $L_{ML} = L_1 \times C$. See Section 32-3.02(b) for multilane superelevation runoff calculations.

② The relative gradient of the superelevation runoff (G_{SR}, decimal) is:

$$G_{SR} = \frac{24e}{L_{ML}} \quad \text{(US Customary)}$$

$$G_{SR} = \frac{7.2e}{L_{ML}} \quad \text{(Metric)}$$

$$RS = \frac{1}{G_{SR}}$$

③ $TR_{ML} = \frac{S_{normal}}{e}\left(L_{ML}\right)$

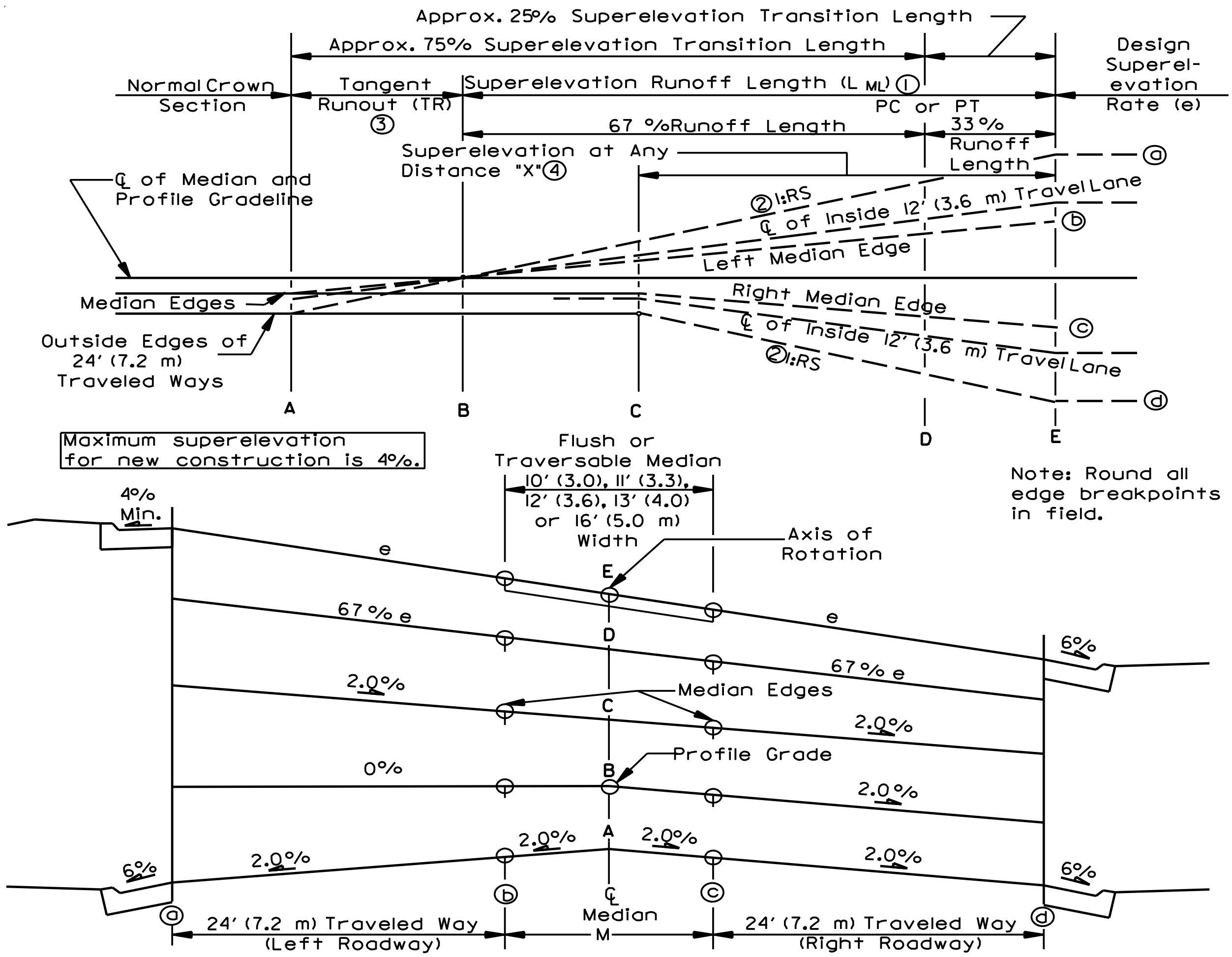
④ Superelevation rate (e) at any distance up to full superelevation attainment:

$$0.02 + \frac{G_{SR} \text{ x Distance "X"}}{24} \quad \text{(US Customary)}$$

$$0.02 + \frac{G_{SR} \text{ x Distance "X"}}{7.2} \quad \text{(Metric)}$$

AXIS OF ROTATION ABOUT EDGE OF CURBED MEDIAN
(Four-Lane Divided Highway With Curbed Median Widths of 18′, 22′, 30′ or 35′ (5.5, 7.0, 9.5 or 10.5 m))

Figure 48-5.E



① $L_{ML} = L_1 \times C$. See Section 32-3.02(b) for multilane superelevation runoff calculations.

The relative gradient of the superelevation runoff (G_{SR}, decimal) is:

$$G_{SR} = \frac{e(7.2 + M/2)}{L_{ML}} \quad \text{(US Customary)}$$

③

$$G_{SR} = \frac{e(24 + M/2)}{L_{ML}}$$

②

$$TR_{ML} = \frac{S_{normal}}{e}\left(L_{ML}\right) \quad \text{(Metric)}$$

$$RS = \frac{1}{G_{SR}}$$

④ Superelevation rate (e) at any distance up to full superelevation attainment:

$$\frac{G_{SR} \times \text{Distance "X"}}{(24 + M/2)} \quad \text{(US Customary)}$$

$$\frac{G_{SR} \times \text{Distance "X"}}{7.2 + M/2} \quad \text{(Metric)}$$

AXIS OF ROTATION ABOUT CENTERLINE OF FLUSH MEDIAN
(Four-Lane Highway with Flush Median or Multi-Lane Highway with a Traversable Type Median (M-2.12 (M-5.30)) 18′, 22′, 30′ or 35′ (5.5, 7.0, 9.5 or 10.5 m))

Figure 48-5.F

48-6 TABLES OF DESIGN CRITERIA

Figures 48-6.A, 48-6.B, and 48-6.C provide the criteria for urban streets with raised-curb medians, two-way left-turn lane medians, and one-way streets. Where it has been decided that the cross section design should be a depressed median with outside shoulders (i.e., open suburban area), use the criteria presented in Chapter 47 for rural four-lane arterials.

The designer should realize that some of the cross section elements included in the figures (e.g., TWLTL) are not automatically warranted in the project design. The values in the figures only apply after the decision has been made to include the element in the highway cross section.

Design Element			Manual Section	Two-Way DHV 2900-2050 (1)	Two-Way DHV 2050-1250 (1)	Two-Way DHV < 1250 (1)
Design Controls	Highway Type		—	TWS-6	TWS-4	TWS-2
	Design Forecast Year		31-4.02	20 Years	20 Years	20 Years
	* Design Speed (**2a**)		48-2.01	30 mph – 45 mph	30 mph – 50 mph (**2b**)	30 mph – 40 mph
	Access Control		35-1	Consider Managed Access	Consider Managed Access	Consider Managed Access
	Level of Service (**3**)		31-4.04	C	C	C
	On-Street Parking (**4**)		48-2.05	Not Recommended	Not Recommended	Not Recommended
Cross Section Elements	* Surface Width	Without Parking	34-2.01	2 @ 38′ e-f	2 @ 26′ e-f	30′ f-f
		With Parking - 1 Side (**5**)		1 @38′ e-f 1 @46′ e-f	1 @ 26′ e-f 1 @ 34′ e-f	36′ f-f
		With Parking - 2 Sides (**5**)		2 @ 46′ e-f	2 @ 34′ e-f	44′ f-f
	Auxiliary Lanes	Lane Width	34-2.03	Single Left & Right: 12′, Min.: 11′ Dual Lefts: 24′, Min.: 22′		
		Curb Type and Width		B-6.12 or B-6.24 CC&G (**6**)		
	Bicycle Lane Width (Shared) (**7**)		Chp. 17	Min.: 13′	Min.: 13′	Min.: 13′
	Cross Slope	*Travel Lanes	34-2.01	1/4″/ft for Two Lanes Adjacent to Median (**8a**)	1/4″/ft for Two Lanes Adjacent to Median	1/4″/ft for Lanes Adjacent to Crown (**8b**)
		Auxiliary Lanes		—	—	—
	Outside Curb Type & Width		34-2.04	B-6.24 CC&G	B-6.24 CC&G	B-6.24 CC&G
	Median Width	Flush/TWLTL	34-3	11′, 12′, 13′ (**9**)		
		Traversable TWLTL		16′		N/A
		Raised-Curb		18′, 22′, 30′		N/A
		Depressed		—	44′ - 50′	—
	Sidewalk Width		48-2.04	5′ with Buffer Strip Behind Curb	5′ with Buffer Strip Behind Curb	5′ with Buffer Strip Behind Curb
	Clear Zone		38-3	(**10**)	(**10**)	(**10**)
Roadway Slopes	Side Slopes	Cut Section (Curbed)	34-4.04	—	—	—
		Rock Cut	34-4.05	—	—	—
		Fill Section (Curbed)	34-4.02	—		
	Median Slopes	Concrete Surface/Traversable	34-3	3/16″/ft	3/16″/ft	N/A
		Flush/TWLTL Surface		1/4″/ft	1/4″/ft	N/A
		Grass Surface		5/8″/ft (Towards C&G)	5/8″/ft (Towards C&G)	N/A

TWS = Two-Way Street, e-f = edge of median to face of curb, f-f = face of curb to face of curb

* Controlling design criteria (see Section 31-8).

GEOMETRIC DESIGN CRITERIA FOR SUBURBAN/URBAN TWO-WAY ARTERIALS
(New Construction/Reconstruction)
(US Customary)

Figure 48-6.A

Design Element			Manual Section	Two-Way DHV 2900-2050	Two-Way DHV 2050-1250	Two-Way DHV < 1250
Bridges	Highway Type		—	TWS-6	TWS-4	TWS-2
	New and Reconstructed Bridges	*Structural Capacity	N/A	HS-20	HS-20	HS-20
		*Clear Roadway Width (**11**)	39-6	76′ plus Median Width	52′ plus Median Width	30′
	Existing Bridges to Remain in Place	*Structural Capacity	N/A	HS-20	HS-20	HS-20
		*Clear Roadway Width (**12**)	39-6	70′ plus Median Width	48′ plus Median Width	28′
	*Vertical Clearance (Arterial Under) (**13a**)	New and Replaced Overpassing Bridges	39-4	14′-9″ (**13b**)		
		Existing Overpassing Bridges		14′-0″ (**13c**)		
		Overhead Signs/ Pedestrian Bridges	33-5	New: 17′-3″ (**13b**)		
	*Vertical Clearance (Arterial over Railroad)		39-4.06	23′-0″		

* Controlling design criteria (see Section 31-8).

GEOMETRIC DESIGN CRITERIA FOR SUBURBAN/URBAN TWO-WAY ARTERIALS
(New Construction/Reconstruction)
(US Customary)
(Continued)

Figure 48-6.A

Design Element			Manual Section	Two-Way DHV 2900-2050 (1)	Two-Way DHV 2050-1250 (1)	Two-Way DHV < 1250 (1)
Design Controls	Highway Type		—	TWS-6	TWS-4	TWS-2
	Design Forecast Year		31-4.02	20 Years	20 Years	20 Years
	*Design Speed (2a)		48-2.01	50 km/h -70 km/h	50 km/h - 80 km/h (2b)	50 km/h - 60 km/h
	Access Control		35-1	Consider Managed Access	Consider Managed Access	Consider Managed Access
	Level of Service (3)		31-4.04	C	C	C
	On-Street Parking (4)		48-2.05	Not Recommended	Not Recommended	Not Recommended
Cross Section Elements	*Surface Width	Without Parking	34-2.01	2 @ 11.4 m e-f	2 @ 7.8 m e-f	9.2 m f-f
		With Parking - 1 Side (5)		1 @ 11.4 m e-f 1 @ 13.8 m e-f	1 @ 7.8 m e-f 1 @ 10.2 m e-f	10.8 m f-f
		With Parking - 2 Sides (5)		2 @ 13.8 m e-f	2 @ 10.2 m e-f	13.2 m f-f
	Auxiliary Lanes	Lane Width	34-2.03	Single Left & Right: 3.6 m, Min.: 3.3 m Dual Lefts: 7.2 m, Min.: 6.6 m		
		Curb Type and Width		B-15.30 or B-15.60 CC&G (6)		
	Bicycle Lane Width (Shared) (7)		Chap. 17	Min.: 4.0 m	Min.: 4.0 m	Min.: 4.0 m
	Cross Slope	*Travel Lanes	34-2.01	2% for Two Lanes Adjacent to Median (8a)	2% for Two Lanes Adjacent to Median	2% for Lanes Adjacent to Crown (8b)
		Auxiliary Lanes		—	—	—
	Outside Curb Type & Width		34-2.04	B-15.60 CC&G	B-15.60 CC&G	B-15.60 CC&G
	Median Width	Flush/TWLTL	34-3	3.3 m, 3.6 m, 4.0 m (9)		
		Traversable TWLTL		New: 5.0 m	Reconstruction: 4.88 m	N/A
		Raised-Curb		5.5 m, 7.0 m, 9.5 m	N/A	
		Depressed		—	13.2 m - 15.0 m	—
	Sidewalk Width		48-2.04	1.5 m with Buffer Strip Behind Curb	1.5 m with Buffer Strip Behind Curb	1.5 m with Buffer Strip Behind Curb
	Clear Zone		38-3	(10)	(10)	(10)
Roadway Slopes	Side Slopes	Cut Section (Curbed)	34-4.04	—	—	—
		Rock Cut	34-4.05	—	—	—
		Fill Section (Curbed)	34-4.02	—		
	Median Slopes	Concrete Surface/Traversable	34-3	1.5%	1.5%	N/A
		Flush/TWLTL Surface		2%	2%	N/A
		Grass Surface		5% (Towards C&G)	5% (Towards C&G)	N/A

TWS = Two-Way Street, e-f = edge of median to face of curb, f-f = face of curb to face of curb

* Controlling design criteria (see Section 31-8).

GEOMETRIC DESIGN CRITERIA FOR SUBURBAN/URBAN TWO-WAY ARTERIALS
(New Construction/Reconstruction)
(Metric)

Figure 48-6.A

Design Element			Manual Section	Two-Way DHV 2900-2050	Two-Way DHV 2050-1250	Two-Way DHV < 1250
Bridges	Highway Type		—	TWS-6	TWS-4	TWS-2
	New and Reconstructed Bridges	*Structural Capacity	N/A	MS-18	MS-18	MS-18
		*Clear Roadway Width (**11**)	39-6	22.8 m plus Median Width	15.6 m plus Median Width	9.2 m
	Existing Bridges to Remain in Place	*Structural Capacity	N/A	MS-18	MS-18	MS-18
		*Clear Roadway Width (**12**)	39-6	21.0 m plus Median Width	14.4 m plus Median Width	8.6 m
	*Vertical Clearance (Arterial Under) (**13a**)	New and Replaced Overpassing Bridges	39-4	4.5 m (**13b**)		
		Existing Overpassing Bridges		4.3 m (**13c**)		
		Overhead Signs/ Pedestrian Bridges	33-5	New: 5.25 m (**13b**)		
	*Vertical Clearance (Arterial over Railroad)		39-4.06	7.0 m		

* Controlling design criteria (see Section 31-8).

GEOMETRIC DESIGN CRITERIAFOR SUBURBAN/URBAN TWO-WAY ARTERIALS
(New Construction/Reconstruction)
(Metric)
(Continued)

Figure 48-6.A

(1) Traffic Volumes. The design hourly volumes (DHV) are calculated using a PHF = 1.0; adjust these values using local peak-hour factors.

(2) Design Speed.

a. Consider using a minimum 40 mph (60 km/h) design speed in relatively undeveloped areas where economics, environmental conditions, and signal spacing permit. The statutory speed limits in urbanized areas is 30 mph. Before the posted speed limit can be increased, complete an engineering study (Phase I report) and a speed study.

b. Only consider the 50 mph (80 km/h) design speed in open-suburban areas. Do not place curb and gutter adjacent to the edges of the traveled way.

(3) Level of Service. In major urban areas, a level of service D may be considered with study and justification.

(4) Minimum Street Width. The minimum width of a two-way, two-lane street is set at 30 ft (9.2 m) f-f which allows two-way traffic to pass a stalled vehicle.

(5) Parking Lane Width. The desirable width of the parking lane is 10 ft (3.0 m) and includes the 2 ft (600 mm) gutter width. The minimum width is 8 ft (2.4 m) e-f.

(6) Gutter Width. Under restricted conditions, the gutter width adjacent to the edge of the turn lane may be narrowed or eliminated adjacent to a 12 ft (3.6 m) lane and narrowed adjacent to a 11 ft (3.3 m) lane.

() Bicycle Lane Width. Width of a shared bicycle lane is dependent on the posted speed of the street. For a posted speed of 45 mph, use a 14 ft (4.2 m) width, and for posted speeds less than 45 mph, use a 13 ft (4.0 m) width.

(8) Cross Slope.

a. For the third lane away from the median, increase the cross slope by 1/16″/ft (0.5%).
b. For reconstruction projects, an existing 3/16″/ft (1.5%) cross slope may remain-in-place.

(9) TWLTL Median Width. Use a 13 ft (4.0 m) wide median width if there are a significant number of trucks making left turns.

(10) Clear Zone. For curbed facilities, the minimum horizontal clearance to an obstruction is 1.5 ft (500 mm), measured from the face of curb.

GEOMETRIC DESIGN CRITERIA FOR SUBURBAN/URBAN TWO-WAY ARTERIALS
(New Construction/Reconstruction)

Footnotes for Figure 48-6.A

(11) New and Reconstructed Bridge Widths. Clear roadway bridge widths are measured from face to face of outside curbs or parapet walls. Urban bridge widths are defined as the sum of the approach traveled way widths, the width of the gutters, and the width of the median. A sidewalk or bikeway will result in additional bridge width. For proposed sidewalks on a bridge, add 5 ft (1.5 m) to each side of the bridge. Parking is prohibited on bridges.

(12) Existing Bridge Widths to Remain in Place. Clear roadway bridge widths are measured from face to face of outside curbs or parapet walls. At least one sidewalk must be carried across the bridge. Add a minimum 5 ft (1.5 m) for the sidewalk width.

(13) Vertical Clearance (Arterial Under).

a. The clearance must be available over the traveled way and flush or traversable median.
b. Table value includes allowance for future overlays.
c. A 14 ft 0 in (4.3 m) clearance may be allowed to remain in place with consideration for reconstruction to a clearance of 14 ft 9 in (4.5 m).

GEOMETRIC DESIGN CRITERIA FOR SUBURBAN/URBAN TWO-WAY ARTERIALS
(New Construction/Reconstruction)

Footnotes For Figure 48-6.A
(Continued)

Design Element			Manual Section	One-Way DHV >1850 (1)	One-Way DHV 1850-1300 (1)	One-Way DHV < 1300 (1)
Design Controls	Highway Type		—	OWS-4	OWS-3	OWS-2
	Design Forecast Year		31-4.02	20 Years	20 Years	20 Years
	*Design Speed **(2)**		48-2.01	30 mph – 40 mph	30 mph – 40 mph	30 mph – 40 mph
	Access Control		35-1	Consider Managed Access	Consider Managed Access	Consider Managed Access
	Level of Service **(3)**		31-4.04	C	C	C
	On-Street Parking		48-2.05	Not Recommended	Not Recommended	Not Recommended
Cross Section Elements	*Surface Width	Without Parking	34-2.01	52′ f-f	40′ f-f	30′ f-f **(4)**
		With Parking - 1 Side **(5)**		60′ f-f	48′ f-f	36′ f-f
		With Parking - 2 Sides **(5)**		68′ f-f	56′ f-f	44′ f-f
	Auxiliary Lanes	Lane Width	34-2.03	Des: 12′ Min: 11′	Des: 12′ Min: 11′	Des: 12′ Min: 11′
		Curb Type and Width **(6)**		B-6.12 or B-6.24 CC&G	B-6.12 or B-6.24 CC&G	B-6.12 or B-6.24 CC&G
	Bicycle Lane Width (Shared) **(7)**		Chp. 17	Min.: 13′	Min.: 13′	Min.: 13′
	Cross Slope	*Travel Lanes **(8)**	34-2.01	3/16″/ft for Lanes Adjacent to Crown	3/16″/ft for Lanes Adjacent to Crown	1/4″/ft for Lanes Adjacent to Crown
		Auxiliary Lanes	34-2.03	—	—	—
	Outside Curb Type & Width		34-2.04	B-6.24 CC&G	B-6.24 CC&G	B-6.24 CC&G
	Sidewalk Width		48-2.04	5′ with Buffer Strip Behind Curb	5′ with Buffer Strip Behind Curb	5′ with Buffer Strip Behind Curb
	Clear Zone		38-3	**(9)**	**(9)**	**(9)**
Roadway Slopes	Side Slopes	Cut Section (Curbed)	34-4.04	—	—	—
		Rock Cut	34-4.05	—	—	—
		Fill Section (Curbed)	34-4.02	—		

OWS = One-Way Street, f-f = face of curb to face of curb

* Controlling design criteria (see Section 31-8).

GEOMETRIC DESIGN CRITERIA FOR SUBURBAN/URBAN ONE-WAY ARTERIALS
(New Construction/Reconstruction)
(US Customary)

Figure 48-6.B

Design Element			Manual Section	One-Way DHV > 1850 (1)	One-Way DHV 1850-1300 (1)	One-Way DHV < 1300 (1)
Bridges	Highway Type		—	OWS-4	OWS-3	OWS-2
	New and Reconstructed Bridges	*Structural Capacity	N/A	HS-20	HS-20	HS-20
		*Clear Roadway Width (**10**)	39-6	52′	40′	30′
	Existing Bridges to Remain in Place	*Structural Capacity	N/A	HS-20	HS-20	HS-20
		*Clear Roadway Width (**11**)	39-6	48′	37′	28′
	*Vertical Clearance (Arterial Under) (**12a**)	New and Replaced Overpassing Bridges	39-4	14′-9″ (**12b**)		
		Existing Overpassing Bridges		14′-0″ (**12c**)		
		Overhead Signs/ Pedestrian Bridges	33-5	New: 17′-3″ (**12b**)		
	*Vertical Clearance (Arterial over Railroad)		39-4.06	23′-0″		

* Controlling design criteria (see Section 31-8).

GEOMETRIC DESIGN CRITERIA FOR SUBURBAN/URBAN ONE-WAY ARTERIALS
(New Construction/Reconstruction)
(US Customary)
(Continued)

Figure 48-6.B

	Design Element		Manual Section	One-Way DHV >1850 (1)	One-Way DHV 1850-1300 (1)	One-Way DHV < 1300 (1)
Design Controls	Highway Type		—	OWS-4	OWS-3	OWS-2
	Design Forecast Year		31-4.02	20 Years	20 Years	20 Years
	* Design Speed **(2)**		48-2.01	50 km/h - 60 km/h	50 km/h - 60 km/h	50 km/h - 60 km/h
	Access Control		35-1	Consider Managed Access	Consider Managed Access	Consider Managed Access
	Level of Service **(3)**		31-4.04	C	C	C
	On-Street Parking		48-2.05	Not Recommended	Not Recommended	Not Recommended
Cross Section Elements	* Surface Width	Without Parking	34-2.01	15.6 m f-f	12.0 m f-f	9.2 m f-f **(4)**
		With Parking - 1 Side **(5)**		18.0 m f-f	14.4 m f-f	10.8 m f-f
		With Parking - 2 Sides **(5)**		20.4 m f-f	16.8 m f-f	13.2 m f-f
	Auxiliary Lanes	Lane Width	34-2.03	Des: 3.6 m Min: 3.3 m	Des: 3.6 m Min: 3.3 m	Des: 3.6 m Min: 3.3 m
		Curb Type and Width **(6)**		B-15.30 or B-15.60 CC&G	B-15.30 or B-15.60 CC&G	B-15.30 or B-15.60 CC&G
	Bicycle Lane Width (Shared) **(7)**		Chp. 17	Min.: 4.0 m	Min.: 4.0 m	Min.: 4.0 m
	Cross Slope	*Travel Lanes **8)**	34-2.01	1.5% for Lanes Adjacent to Crown	1.5% for Lanes Adjacent to Crown	2% for Lanes Adjacent to Crown
		Auxiliary Lanes	34-2.03	—	—	—
	Outside Curb Type & Width		34-2.04	B-15.60 CC&G	B-15.60 CC&G	B-15.60 CC&G
	Sidewalk Width		48-2.04	1.5 m with Buffer Strip Behind Curb	1.5 m with Buffer Strip Behind Curb	1.5 m with Buffer Strip Behind Curb
	Clear Zone		38-3	**(9)**	**(9)**	**(9)**
Roadway Slopes	Side Slopes	Cut Section (Curbed)	34-4.04	—	—	—
		Rock Cut	34-4.05	—	—	—
		Fill Section (Curbed)	34-4.02	—		

OWS = One-Way Street, f-f = face of curb to fact of curb

* Controlling design criteria (see Section 31-8).

GEOMETRIC DESIGN CRITERIA FOR SUBURBAN/URBAN ONE-WAY ARTERIALS
(New Construction/Reconstruction)
(Metric)

Figure 48-6.B

Design Element			Manual Section	One-Way DHV > 1850 (1)	One-Way DHV 1850-1300 (1)	One-Way DHV < 1300 (1)
Bridges	Highway Type		—	OWS-4	OWS-3	OWS-2
	New and Reconstructed Bridges	*Structural Capacity	N/A	MS-18	MS-18	MS-18
		*Clear Roadway Width (**10**)	39-6	15.6 m	12.0 m	9.2 m
	Existing Bridges to Remain in Place	*Structural Capacity	N/A	MS-18	MS-18	MS-18
		*Clear Roadway Width (**11**)	39-6	14.4 m	11.1 m	8.6 m
	*Vertical Clearance (Arterial Under) (**12a**)	New and Replaced Overpassing Bridges	39-4	4.5 m (**12b**)		
		Existing Overpassing Bridges		4.3 m (**12c**)		
		Overhead Signs/ Pedestrian Bridges	33-5	New: 5.25 m (**12b**)		
	*Vertical Clearance (Arterial over Railroad)		39-4.06	7.0 m		

* Controlling design criteria (see Section 31-8).

GEOMETRIC DESIGN CRITERIA FOR SUBURBAN/URBAN ONE-WAY ARTERIALS
(New Construction/Reconstruction)
(Metric)
(Continued)

Figure 48-6.B

(1) Traffic Volumes. The design hourly volumes (DHV) are calculated using a PHF = 1.0; adjust these values using local peak-hour factors.

(2) Design Speed. Consider using a minimum 40 mph (60 km/h) design speed in relatively undeveloped areas where economics, environmental conditions, and signal spacing permit. The statutory speed limits in urbanized areas is 30 mph. Before the posted speed limit can be increased, complete an engineering study (Phase I report) and a speed study.

(3) Level of Service. In major urban areas, a level of service D may be considered with study and justification.

(4) Minimum Street Width. The minimum width of a two-lane street is set at 30 ft (9.2 m) f-f which allows two lanes of traffic to pass a stalled vehicle.

(5) Parking Lane Width. The desirable width of the parking lane is 10 ft (3.0 m) and includes the 2 ft (600 mm) gutter width. The minimum width is 8 ft (2.4 m) e-f.

(6) Gutter Width. Under restricted conditions, the gutter width adjacent to the edge of the turn lane may be narrowed or eliminated adjacent to a 12 ft (3.6 m) lane and narrowed adjacent to a 11 ft (3.3 m) lane.

(7) Bicycle Lane Width. Width of a shared bicycle lane is dependent on the posted speed of the street. For a posted speed of 45 mph, use a 14 ft (4.2 m) width, and for posted speeds less than 45 mph, use a 13 ft (4.0 m) width.

(8) Cross Slope. For each additional lane away from the crown lanes, including auxiliary lanes, increase the cross slopes by 1/16″/ft (0.5%) up to a maximum of 3/16″/ft (2.5%).

(9) Clear Zone. For curbed facilities, the minimum horizontal clearance to an obstruction is 1.5 ft (500 mm), measured from the face of curb.

(10) New and Reconstructed Bridge Widths. Clear roadway bridge widths are measured from face to face of outside curbs or parapet walls. Urban bridge widths are defined as the sum of the approach traveled way widths and width of the gutters. A sidewalk or bikeway will result in additional bridge width. For sidewalks on a bridge, add 5 ft (1.5 m) to each side of the bridge. Parking is prohibited on bridges.

(11) Existing Bridge Widths to Remain in Place. Clear roadway bridge widths are measured from face to face of outside curbs or parapet walls. At least one sidewalk must be carried across the bridge. Add a minimum 5 ft (1.5 m) for the sidewalk width.

(12) Vertical Clearance (Arterial Under).

a. The clearance must be available over the traveled way.
b. Table value includes allowance for future overlays.
c. A 14 ft 0 in (4.3 m) clearance may be allowed to remain in place with consideration for reconstruction to a clearance of 15 ft 0 in (4.5 m).

GEOMETRIC DESIGN CRITERIA FOR SUBURBAN/URBAN ONE-WAY ARTERIALS
(New Construction/Reconstruction)

Footnotes for Figure 48-6.B

Design Element		Manual Section	Design Speed			
			30 mph	40 mph	45 mph	50 mph
* Stopping Sight Distance (1)		31-3.01	200′	305′	360′	425′
Decision Sight Distance (2)		31-3.02	620′	825′	800′	890′
Intersection Sight Distance (3)		36-6	335′	445′	500′	555′
* Minimum Radii	e_{max} = 6% (open-roadway)	32-2.03/48-5	N/A	N/A	N/A	835′
	e_{max} = 4% (open-roadway)		N/A	N/A	N/A	930′
	e_{max} = 4% (low speed)		250′	535′	710′	N/A
* Superelevation Rate		48-5/32-3	e_{max} = 4% (4a)			e_{max} = 6% or 4% (4b)
* Horizontal Sight Distance		32-4	(5)			
* Vertical Curvature (K-values	Crest	33-4	19	44	61	84
	Sag		37	64	79	96
* Maximum Grade	Level	33-2.02	8%	7%	6%	4%
	Rolling		9%	8%	7%	5%
Minimum Grade		33-2.02	Desirable: 0.5% Minimum: 0.3% (with Curb and Gutter)			

* Controlling design criteria (see Section 31-8).

Footnotes:

(1) Stopping Sight Distance. Table values are for passenger cars on level grades.

(2) Decision Sight Distance. Table values 30 mph and 40 mph are for the avoidance maneuver on an urban street (speed/path/direction change) and for 45 mph and 50 mph for a suburban street.

(3) Intersection Sight Distance. Table values are for passenger cars. See Section 36-6 for trucks.

(4) Superelevation Rate:

a. For reconstruction projects with a design speed ≤ 45 mph, a maximum superelevation rate of 6% may remain in place.
b. The superelevation rate of 6% only may be used in open suburban areas.

(5) Horizontal Sight Distance. For a given design speed, the necessary middle ordinate will be determined by the radius of curve and the required sight distance.

ALIGNMENT CRITERIA FOR SUBURBAN/URBAN ARTERIALS
(New Construction/Reconstruction)
(US Customary)

Figure 48-6.C

Design Element		Manual Section	Design Speed			
			50 km/h	60 km/h	70 km/h	80 km/h
* Stopping Sight Distance (1)		31-3.01	64 m	83 m	105 m	129 m
Decision Sight Distance (2)		31-3.02	195 m	235 m	235 m	270 m
Intersection Sight Distance (3)		36-6	105 m	126 m	146 m	167 m
* Minimum Radii	e_{max} = 6% (open-roadway)	32-2.03/48-5	N/A	N/A	N/A	255 m
	e_{max} = 4% (open-roadway)		N/A	N/A	N/A	280 m
	e_{max} = 4% (low speed)		90 m	135 m	205 m	N/A
* Superelevation Rate		48-5/32-3	e_{max} = 4% (4a)			e_{max} = 6% or 4% (4b)
* Horizontal Sight Distance		32-4	(5)			
* Vertical Curvature (K-values)	Crest	33-4	7	11	17	26
	Sag		12	17	23	30
* Maximum Grade	Level	33-2.02	8%	7%	6%	4%
	Rolling		9%	8%	7%	5%
Minimum Grade		33-2.02	Desirable: 0.5% Minimum: 0.3% (with Curb and Gutter)			

* Controlling design criteria (see Section 31-8).

Footnotes:

(1) Stopping Sight Distance. Table values are for passenger cars on level grades.

(2) Decision Sight Distance. Table values 50 km/h and 60 km/h are for the avoidance maneuver on an urban street (speed/path/direction change) and for 70 km/h and 80 km/h for a suburban street.

(3) Intersection Sight Distance. Table values are for passenger cars. See Section 36-6 for trucks.

(4) Superelevation Rate:

a. For reconstruction projects with a design speed ≤ 70 km/h, a maximum superelevation rate of 6% may remain in place.
b. The superelevation rate of 6% only may be used in open suburban areas.

(5) Horizontal Sight Distance. For a given design speed, the necessary middle ordinate will be determined by the radius of curve and the required sight distance.

ALIGNMENT CRITERIA FOR SUBURBAN/URBAN ARTERIALS
(New Construction/Reconstruction)
(Metric)

Figure 48-6.C

48-7 REFERENCES

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